EP-87669

PCT WORLD INTELLECTUAL PROPERTY ORGANIZATION
International Bureau

INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification 6 : B24B 39/04, B60B 3/06 — A1

(11) International Publication Number: **WO 98/41360**

(43) International Publication Date: 24 September 1998 (24.09.98)

(21) International Application Number: PCT/US98/05808

(22) International Filing Date: 19 March 1998 (19.03.98)

(30) Priority Data:
60/039,628 19 March 1997 (19.03.97) US

(71) Applicant *(for all designated States except US)*: HAYES WHEELS INTERNATIONAL, INC. [US/US]; 38481 Huron River Drive, Romulus, MI 48174 (US).

(72) Inventor; and
(75) Inventor/Applicant *(for US only)*: BAUMGARTEN, John, M. [US/US]; 22780 Deerfield Road, Novi, MI 48375 (US).

(74) Agent: MOLNAR, John, B.; MacMillan, Sobanski & Todd, 4th floor, One Maritime Plaza, 720 Water Street, Toledo, OH 43604 (US).

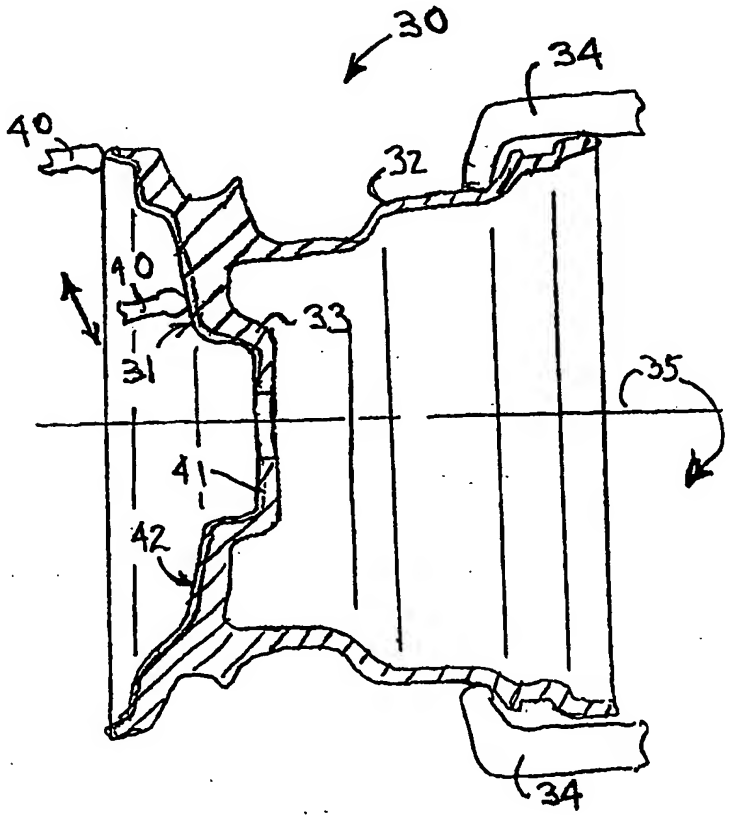
(81) Designated States: AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CU, CZ, DE, DK, EE, ES, FI, GB, GE, GH, GM, GW, HU, ID, IL, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, UA, UG, US, UZ, VN, YU, ZW, ARIPO patent (GH, GM, KE, LS, MW, SD, SZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, ML, MR, NE, SN, TD, TG).

Published
With international search report.
Before the expiration of the time limit for amending the claims and to be republished in the event of the receipt of amendments.

(54) Title: BURNISHED VEHICLE WHEEL

(57) Abstract

A vehicle wheel (30) has an outboard face which includes a burnished portion to provide a cosmetic finish to the wheel face. The method for burnishing the portion of the wheel face.



FOR THE PURPOSES OF INFORMATION ONLY

Codes used to identify States party to the PCT on the front pages of pamphlets publishing international applications under the PCT.

AL	Albania
AM	Armenia
AT	Austria
AU	Australia
AZ	Azerbaijan
BA	Bosnia and Herzegovina
BB	Barbados
BE	Belgium
BF	Burkina Faso
BG	Bulgaria
BJ	Benin
BR	Brazil
BY	Belarus
CA	Canada
CF	Central African Republic
CG	Congo
CH	Switzerland
CI	Côte d'Ivoire
CM	Cameroon
CN	China
CU	Cuba
CZ	Czech Republic
DE	Germany
DK	Denmark
EE	Estonia
ES	Spain
FI	Finland
FR	France
GA	Gabon
GB	United Kingdom
GE	Georgia
GH	Ghana
GN	Guinea
GR	Greece
HU	Hungary
IE	Ireland
IL	Israel
IS	Iceland
IT	Italy
JP	Japan
KE	Kenya
KG	Kyrgyzstan
KP	Democratic People's Republic of Korea
KR	Republic of Korea
KZ	Kazakstan
LC	Saint Lucia
LI	Liechtenstein
LK	Sri Lanka
LR	Liberia
LS	Lesotho
LT	Lithuania
LU	Luxembourg
LV	Latvia
MC	Monaco
MD	Republic of Moldova
MG	Madagascar
MK	The former Yugoslav Republic of Macedonia
ML	Mali
MN	Mongolia
MR	Mauritania
MW	Malawi
MX	Mexico
NE	Niger
NL	Netherlands
NO	Norway
NZ	New Zealand
PL	Poland
PT	Portugal
RO	Romania
RU	Russian Federation
SD	Sudan
SE	Sweden
SG	Singapore
SI	Slovenia
SK	Slovakia
SN	Senegal
SZ	Swaziland
TD	Chad
TG	Togo
TJ	Tajikistan
TM	Turkmenistan
TR	Turkey
TT	Trinidad and Tobago
UA	Ukraine
UG	Uganda
US	United States of America
UZ	Uzbekistan
VN	Viet Nam
YU	Yugoslavia
ZW	Zimbabwe

TITLE

BURNISHED VEHICLE WHEEL

CROSS REFERENCE TO RELATED APPLICATION

This application claims the benefit of U.S. Provisional Application No. 60/039,628, filed March 19, 1997.

BACKGROUND OF THE INVENTION

This invention relates in general to vehicle wheels and in particular to a vehicle wheel having an outboard face which includes a burnished portion to provide a cosmetic finish to the wheel face and a method for burnishing the portion of the wheel face.

Vehicle wheels typically include an annular wheel rim and a circular wheel disc. The wheel disc can be formed across the outboard end of the wheel rim or recessed within the wheel rim. The wheel rim is adapted to carry a pneumatically inflated tire. The wheel rim has inboard and outboard tire retaining flanges formed on the ends thereof which extend in an outward radial direction to retain the tire on the wheel. Inboard and outboard tire bead seats are formed on the outer surface of the wheel rim adjacent to the corresponding tire retaining flange to support the tire walls and form an air-tight seal therewith. The wheel rim also includes a reduced diameter deep well between the tire bead seats to facilitate mounting the tire upon the wheel.

The wheel disc includes a central wheel hub for mounting the wheel upon a vehicle. The inboard face of the wheel hub is typically machined to form a flat surface to assure good contact between the wheel and the vehicle. A pilot hole and a plurality of wheel stud holes extend through the wheel hub. The pilot hole

is centered on the hub and the stud holes are spaced equally about a bolt circle which is concentric with the pilot hole. The pilot hole can receive the end of an axle while the wheel stud holes receive wheel studs for attaching the wheel to the vehicle. The wheel disc also typically includes a plurality of wheel spokes which extend radially from the wheel hub to the wheel rim and support the hub within the rim.

Referring now to the drawings, a flow chart for a wheel manufacturing process is shown in Fig. 1. In function block 10, a wheel cast in a single piece from a light weight metal such as aluminum, magnesium or titanium, or an alloy of a light weight metal. Such wheels are becoming increasingly popular because they weigh less than conventional steel wheels and can include outboard wheel disc faces which are formed in a pleasing aesthetic shape. One piece wheel castings are usually formed by a gravity or low pressure casting process. The wheel castings are finished by machining to a final shape.

Two separate machining stations are typically used to finish a wheel casting. In functional block 11, the outboard end of a rough wheel casting is clamped to the face of a first wheel lathe which is located at the first machining station for a first set of machining operations. A wheel lathe is a dedicated machine designed to finish wheels. Wheel lathes typically include a plurality of cutting tools mounted upon a lathe turret. The turret is indexed to sequentially move each of the tools to the surface of the wheel casting. Wheel lathes are usually operated under computer numerical control (CNC) to sequentially perform a number of related machining operations. For example, a wheel lathe turret can be equipped with a turning tool, a facing tool and a drill bit and the wheel lathe can be programmed to sequentially turn, face and bore a wheel casting. The wheel lathe face typically includes a chuck having a plurality of jaws which grip the outboard wheel retaining flange and tire bead seat.

Consequently, the outboard wheel rim end is not finished during the first set of machining operations.

The outside and inside surfaces of the wheel rim are turned to their final shapes and the inboard surface of the wheel hub is faced in functional block 12. Additionally, the inboard end of the wheel rim is finished. The partially finished wheel casting is removed from the first wheel lathe, reversed and clamped on a second wheel lathe for a second set of machining operations in functional block 13. During the second set of machining operations, the inboard wheel flange and tire bead seat are gripped in the jaws of the wheel lathe chuck, exposing the outboard surface of the wheel disc and the outboard end of the wheel rim for machining.

In functional block 14, the second wheel lathe turns and faces the outboard wheel face. During these operations, the outboard tire retaining flange and the outboard tire bead seat also are turned to final shapes. The surface of the hubcap retention area is machined to final shape and the stud mounting holes are drilled through the hub in functional block 15. Alternately, the wheel casting may be removed from the wheel lathe and the drilling operation completed at another work station.

During the facing and other machining operations, very fine grooves are formed in the surfaces of the wheel. Accordingly, the surface of the wheel is typically subjected to a finishing step, as shown in functional block 16. A typical finishing process involves polishing the wheel surface to smooth the grooves and provide a lusterous appearance to the surface of the wheel. The polishing is usually followed by application of a clear coating to protect the polished wheel surface.

A typical polishing operation is illustrated by a flow chart in Fig. 2. Polishing typically involves a first step of rough buffing with an abrasive

compound as shown in functional block 20. The buffed wheel is degreased in functional block 21. One frequently used method of degreasing involves passing the wheel through a chamber which is filled with a vapor of a solvent. The solvent condenses upon wheel, covering the entire wheel surface. Once the solvent has had a sufficient time to dissolve any surface grease, the solvent is washed from the wheel to complete the degreasing. As shown in functional block 22, the wheel is then wet polished with a liquid lubricant for the polishing abrasive. The wheel is usually rotated and rotating polishing wheels are applied to the surface while a slurry of polishing abrasive and a carrier fluid is applied to the wheel surface. Next the wheel is rinsed in functional block 23. Typically, deionized water is used for the rinse.

The wheel surface is prepared for coating in functional block 24. Typically, the wheel is immersed in a chromate bath. Finally, a clear coating is applied to the wheel in functional block 25. Usually, the clear coating is sprayed onto the wheel while the wheel is slowly rotated. The coating is then heated in a curing oven.

SUMMARY OF THE INVENTION

This invention relates to a wheel having an outboard face which includes a burnished portion to provide a cosmetic finish to the wheel face and a method for burnishing the portion of the wheel face.

As described above, it is known to buff or polish a wheel surface. However, such processes require abrasives and solvents. Typical solvents include trichloroethylene, trichloroethane, sulfuric acid and perchloroethylene, which are toxic. Additionally, the lubricants for the abrasives can include animal lubricants such as grease and lard. The polishing wheels can produce air-borne lint during the polishing and buffing operation. Accordingly, it is necessary to

protect the workers from these materials and collect and dispose of the residues. Because of the complexity of the polishing operations and the need to appropriately control the environmental impact of the materials utilized, wheels are often shipped to a contractor for polishing. This involves additional time and expense. Thus, it would be desirable to smooth the wheel face without polishing the wheel.

The present invention contemplates a vehicle wheel comprising an annular wheel rim portion and a wheel disc formed across the wheel rim. The wheel disc has an outboard face which includes a burnished portion to provide a pleasing cosmetic appearance. It is further contemplated that the burnished portion of the wheel disc face can extend over the entire surface of the wheel disc outboard face. An optional protective coating can be formed over the burnished portion of the wheel disc face.

The present invention further includes a process for forming a decorative surface upon a vehicle wheel face which comprises providing a machined vehicle wheel including a wheel rim and having a wheel disc extending radially across the wheel rim. The machined wheel is mounted in a lathe. The wheel is rotated while a burnishing tool is urged against the outboard surface of the wheel disc to smooth a portion of the wheel disc surface. The invention also contemplates burnishing the entire outboard face of the wheel disc. Subsequent to burnishing the wheel face, an optional protective coating can be applied to the burnished surface.

Various objects and advantages of this invention will become apparent to those skilled in the art from the following detailed description of the preferred embodiment, when read in light of the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a flow chart for a known process for manufacturing a one piece vehicle wheel.

Fig. 2 is a flow chart for a known process for polishing a one piece vehicle wheel.

Fig. 3 is a sectional view of a burnished vehicle wheel and illustrates a process for burnishing the vehicle wheel face in accordance with the invention.

Fig. 4 illustrates a burnishing tool used in the burnishing shown in Fig. 3.

Fig. 5 illustrates an alternate embodiment of the burnishing tool shown in Fig. 3.

Fig. 6 is a flow chart for manufacturing a one piece vehicle wheel which utilizes the burnishing process illustrated in Fig. 3.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring again to the drawings, there is illustrated in Fig. 3, a sectional view of a one piece wheel 30 having a burnished outboard surface 31 and a process for burnishing the wheel 30 in accordance with the present invention. Burnishing involves rubbing a smooth hard tool under considerable pressure over the minute surface protrusions that are formed in a metal surface during machining. Burnishing reduces the depth and sharpness of the protrusions through plastic flow of the metal. As the tool moves, the microscopic peaks in the work surface are compressed into the adjacent hollows, which densifies the surface of the metal. Burnishing simultaneously smoothes and compresses the work surface. The resulting mechanical forces, which impart compression stresses to the wheel, both on the surface and down to a certain depth of the work, increase the lifetime of the metal with respect to contact corrosion and fatigue. Additionally, the cosmetic appearance of the wheel is enhanced as

surface imperfections such as pits or oxides are plastically deformed into the surface of the wheel. An increased brightness or shine of the wheel surface is expected from the burnishing process. Thus, the present invention is directed to burnishing the visible portions of a wheel face, which includes portions of the wheel which are not subjected to stress, to cosmetically improve the appearance of the wheel face.

As shown in Fig. 3, the wheel 30 includes an annular wheel rim 32. A wheel disc 33 which includes the outboard surface 31 extends radially across the outboard end of the wheel rim 32. The invention contemplates mounting an inboard end of the wheel rim 32 in the jaws 34 of a lathe or a spinner chuck of a wheel lathe (not shown).

The wheel 30 is rotated about an axis 35, as shown by the arrow in Fig. 3, by the wheel lathe. A burnishing tool 40 mounted upon the lathe turret (not shown) is urged against the outboard wheel face 31. The tool 30 is traversed in a radial direction from the outboard end of the wheel rim 32 across the wheel face 31. The tool 40 moves alternately toward and away from the center of the wheel disc 33, as shown by the small arrows in Fig. 3. As the tool 40 moves across the wheel face 31, the tool 40 also is moved axially to follow the contour of the wheel face 31. The invention further contemplates that the burnishing tool 40 can be inclined to burnish all possible inclinations of the wheel face 31, such as horizontal, vertical or inclined. Additionally, the tool 40 can be advanced in an axial, or radial, direction to increase the force exerted upon the wheel face 31. The surface of the wheel face 31 is plastically deformed and smoothed as the tool 40 passes thereover to form a burnished portion 41 of the wheel face 31.

The invention further contemplates a protective coating 42 which covers the burnished portion 41 of the wheel; however, such a coating 42 is optional. In

the preferred embodiment, the protective coating 42 is a clear coating; however, other coatings can be applied to the burnished portion 41.

In the preferred embodiment, the burnishing tool 40 includes a very hard steel ball 43 mounted or formed upon an end of a tool bar 44, as shown in Fig. 4. the ball 43 has a mirror or very smooth surface and a hardness which is greater than 62 R_C. Alternately, the tool 40 can be a hardened roller 45 which turns on a shaft 46 mounted in the slotted end of a tool bar 47, as shown in Fig. 5.

A process for burnishing the wheel face is illustrated by the flow chart shown in Fig. 6. Steps shown in Fig. 6 which are similar to steps shown in Figs. 1 and 2 have the same numerical designators. In functional block 10 a vehicle wheel is cast by a conventional casting process, such as, for example, gravity or low pressure casting. In functional blocks 11 through 15, the wheel casting is machined to a final shape as described above.

In functional block 51, the outboard wheel face is burnished on a wheel lathe or other conventional wheel finishing machine. The wheel is rotated upon the wheel lathe while a burnishing tool is urged against and moved radially across the outboard wheel face. Once the desired surface finish has been achieved, the wheel is removed from the wheel lathe in functional block 52.

The wheel can then be finished with a surface preparation in functional block 25 followed by a coating and curing of the coating in functional block 25. As described above, application of the protective coating to the burnished surface is optional. Thus, the present invention contemplates that burnishing is included as one of the steps in the prior art process for machining a wheel casting. For example, a burnishing tool can be added to the turret of the wheel lathe used to machine the wheel casting and the burnishing operation included as one of the programmed machining steps for finishing the wheel casting. Alternately, a

burnishing station, which is dedicated to burnishing the wheel faces, can be established at the wheel manufacturing facility.

While the preferred embodiment has been described and illustrated above as burnishing the entire outboard wheel face, it will be appreciated that only a portion of the wheel face can be burnished. For example, the esthetic design of the wheel may require that only a portion of the wheel face is to be lusterous with the remainder remaining as machined or painted. Accordingly, only the portion which is desired to be luterous would be burnished. Similarly, the invention also contemplates that entire surface of wheel can be burnished to provide both an improvement in the cosmetic appearance to the wheel and the enhanced mechanical properties mentioned above which result from the compression stresses imparted by the burnishing process. Also, while the preferred embodiment has been described as being applied to cast wheels, it will be appreciated that the cosmetic appearance of wheels formed by other conventional processes also can be improved by burnishing. For example, the present invention also contemplates burnishing the outboard surface of forged or stamped wheel discs.

The inventor expects that burnishing of the wheel face to enhance the cosmetic appearance thereof will cost less than buffing or polishing of the wheel face. Also, because the wheel can be burnished on existing wheel lathes, no capital cost for polishing machines is required. The burnishing process eliminates both the exposure of personnel to toxic substances utilized during polishing and the expense of disposing of the toxic wastes generated thereby. Production time and cost will also be reduced since the need to ship the wheel to a polishing contractor will be eliminated. The burnishing tool can extend into the wheel rim to reach the surface of a recessed wheel disc, which can be difficult to reach with polishing wheels. Burnishing preserves crisp edge

surfaces which may be aesthetically desirable. Such edges tend to be blunted or removed by the abrasive nature of the polishing process. As described above, because surface imperfections such as pits or oxides are plastically deformed into the surface of the wheel face, a better brightness or shine of the wheel face is expected. While polishing tends to highlight surface imperfections, burnishing tends to hide such surface imperfections. Additionally, fatigue resistance of the wheel is increased over that obtained by polishing due to the residual compressive stresses induced in the wheel surface by the burnishing process.

In accordance with the provisions of the patent statutes, the principle and mode of operation of this invention have been explained and illustrated in its preferred embodiment. However, it must be understood that this invention may be practiced otherwise than as specifically explained and illustrated without departing from its spirit or scope. For example, while the preferred embodiment has been described for a one piece vehicle wheel, it will be appreciated that the invention also can be practiced upon two piece vehicle wheels having cast full face modular wheel discs. Also, the invention can be practiced upon a wheel spider which is disposed within a wheel rim. Additionally, while burnishing of only wheel faces has been described above, the invention also contemplates burnishing other machined wheel surfaces.

What is claimed is:

1. A vehicle wheel comprising:

an annular wheel rim portion; and

a wheel disc formed across said wheel rim, said wheel disc having an outboard face, said outboard face including burnished portion which provides a pleasing cosmetic appearance.

2. A vehicle wheel according to claim 1 wherein said burnished portion of said wheel disc face extends over the entire surface of said wheel disc outboard face.

3. A vehicle wheel according to claim 2 further including a protective coating formed over said burnished portion of said wheel disc face.

4. A vehicle wheel according to claim 3 wherein said protective coating is a clear coating.

5. A process for forming a decorative surface upon a vehicle wheel face comprising the steps of:

(a) providing a machined vehicle wheel including a wheel rim and having a wheel disc extending radially across the wheel rim;

(b) mounting the wheel in a lathe;

(c) rotating the wheel; and

(d) urging a burnishing tool against the outboard surface of the wheel disc to smooth a portion of the wheel disc surface; and

6. A process according to claim 5 further including, subsequent to step (d), removing the burnished wheel from the lathe.

7. A process according to claim 5 wherein the entire outboard face of the wheel disc is burnished in step (c).

8. A process according to claim 5 further including, subsequent to step (d), applying a protective coating to the burnished surface.

9. A process according to claim 8 wherein the coating is a clear coating.

10. A process according to claim 5 wherein the burnishing tool includes a spherical surface which is pressed against the wheel surface in step (d).

11. A process according to claim 5 wherein the burnishing tool includes a roller which is pressed against the wheel surface in step (d).

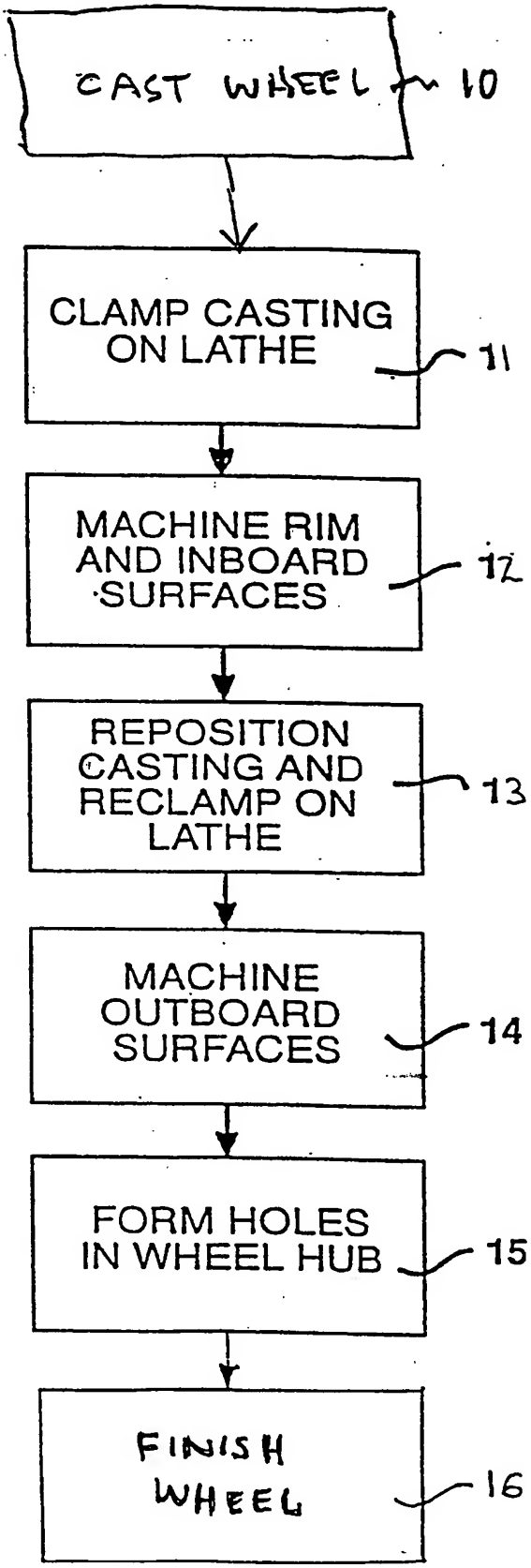


FIG. 1
PRIOR ART

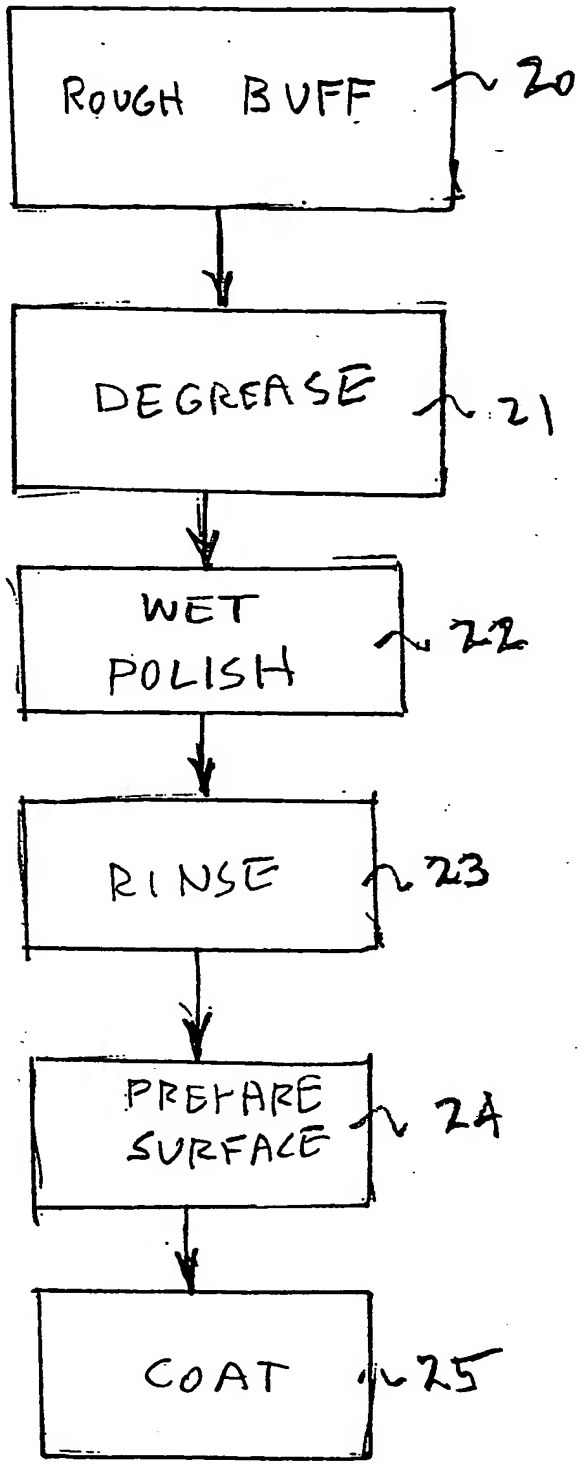


FIG. 2

(PRIOR ART)

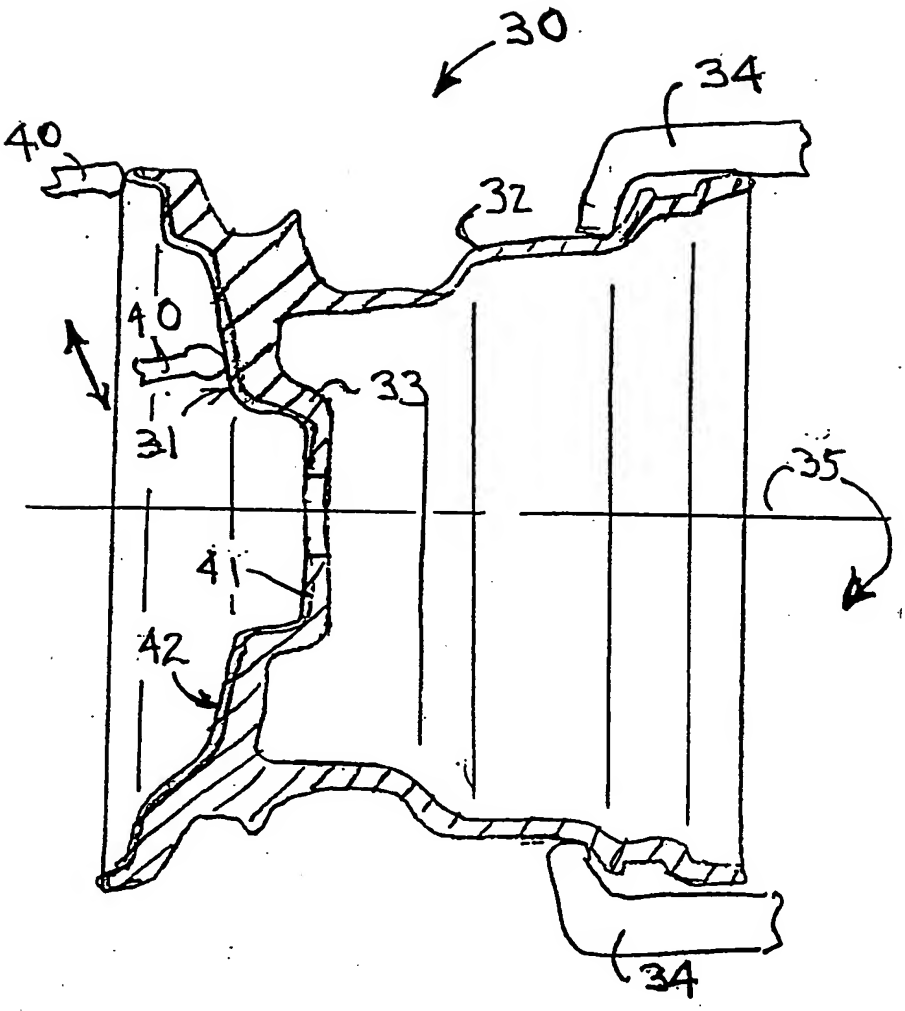


FIG. 3

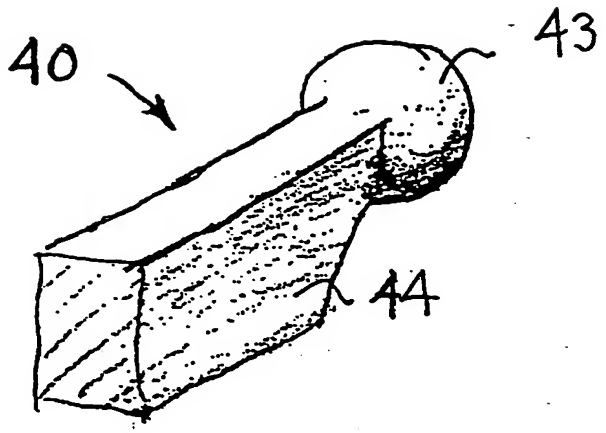


FIG. 4

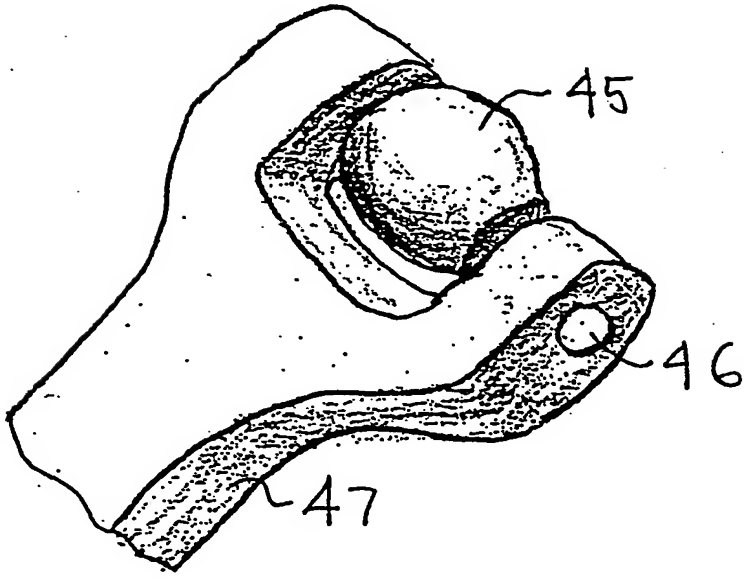


FIG. 5

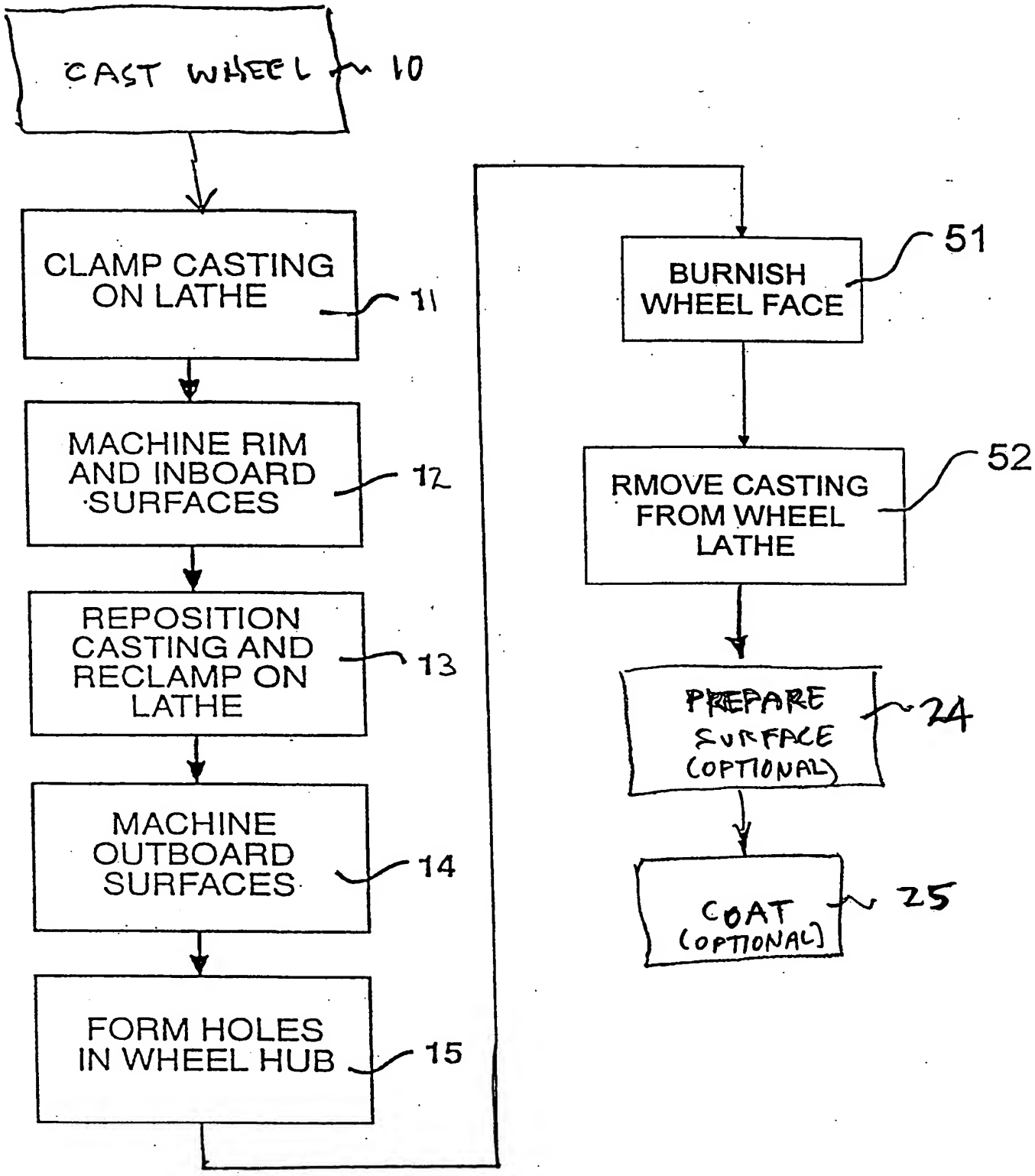

CAST WHEEL
10
CLAMP CASTING ON LATHE
11
MACHINE RIM AND INBOARD SURFACES
12
REPOSITION CASTING AND RECLAMP ON LATHE
13
MACHINE OUTBOARD SURFACES
14
FORM HOLES IN WHEEL HUB
15
BURNISH WHEEL FACE
51
RMOVE CASTING FROM WHEEL LATHE
52
PREPARE SURFACE (OPTIONAL)
24
COAT (OPTIONAL)
25

FIG. 6

INTERNATIONAL SEARCH REPORT

International Application No
PCT/US 98/05808

A. CLASSIFICATION OF SUBJECT MATTER
IPC 6 B24B39/04 B60B3/06

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 6 B24B B60B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 4 835 826 A (WILSON) 6 June 1989 see column 2, line 57 - column 4, line 46; figures	1,5,10, 11
X	US 5 099 558 A (WILSON) 31 March 1992 see column 2, line 57 - column 4, line 41; figures	1,5,10, 11
X	US 5 329 684 A (BUDET) 19 July 1994 see column 3, line 59 - column 8, line 12; figures	1,5

-/--

[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

° Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
14 July 1998	21/07/1998

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Vanneste, M

Form PCT/ISA/210 (second sheet) (July 1992)

INTERNATIONAL SEARCH REPORT

International Application No
PCT/US 98/05808

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication,where appropriate, of the relevant passages	Relevant to claim No.
A	PATENT ABSTRACTS OF JAPAN vol. 008, no. 212 (C-244), 27 September 1984 & JP 59 098774 A (TOYOTA JIDOSHA KK), 7 June 1984, see abstract	3,4
A	PATENT ABSTRACTS OF JAPAN vol. 096, no. 004, 30 April 1996 & JP 07 329502 A (NISSAN MOTOR CO LTD), 19 December 1995, see abstract	3,4
A	DE 26 24 610 A (NSU) 8 December 1977 see page 4, line 17 - page 5, line 6; figures	1

Form PCT/ISA/210 (continuation of second sheet) (July 1992)

INTERNATIONAL SEARCH REPORT

Information on patent family members

In tional Application No
PCT/US 98/05808

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 4835826 A	06-06-1989	US 5099558 A	31-03-1992
US 5099558 A	31-03-1992	US 4835826 A	06-06-1989
US 5329684 A	19-07-1994	FR 2687341 A EP 0556102 A	20-08-1993 18-08-1993
DE 2624610 A	08-12-1977	NONE	

CORRECTED VERSION*

PCT

WORLD INTELLECTUAL PROPERTY ORGANIZATION
International Bureau

INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification 6 :
B24B 39/04, B60B 3/06

A1

(11) International Publication Number: **WO 98/41360**

(43) International Publication Date: 24 September 1998 (24.09.98)

(21) International Application Number: PCT/US98/05808

(22) International Filing Date: 19 March 1998 (19.03.98)

(30) Priority Data:
60/039,628 19 March 1997 (19.03.97) US

(71) Applicant *(for all designated States except US)*: HAYES WHEELS INTERNATIONAL, INC. [US/US]; 38481 Huron River Drive, Romulus, MI 48174 (US).

(72) Inventor; and
(75) Inventor/Applicant *(for US only)*: BAUMGARTEN, John, M. [US/US]; 22780 Deerfield Road, Novi, MI 48375 (US).

(74) Agent: MOLNAR, John, B.; MacMillan, Sobanski & Todd, 4th floor, One Maritime Plaza, 720 Water Street, Toledo, OH 43604 (US).

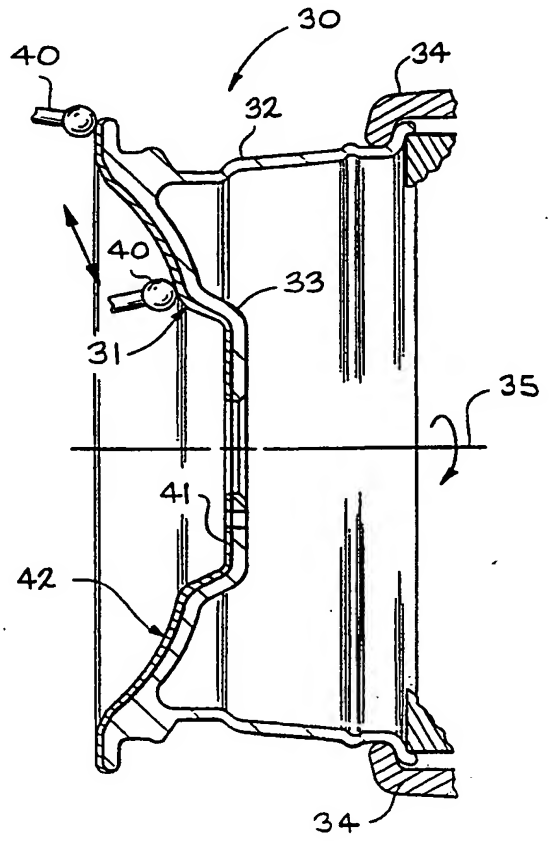
(81) Designated States: AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CU, CZ, DE, DK, EE, ES, FI, GB, GE, GH, GM, GW, HU, ID, IL, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, UA, UG, US, UZ, VN, YU, ZW, ARIPO patent (GH, GM, KE, LS, MW, SD, SZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, ML, MR, NE, SN, TD, TG).

Published
With international search report.
Before the expiration of the time limit for amending the claims and to be republished in the event of the receipt of amendments.

(54) Title: BURNISHED VEHICLE WHEEL

(57) Abstract

A vehicle wheel (30) has an outboard face which includes a burnished portion to provide a cosmetic finish to the wheel face. The method for burnishing the portion of the wheel face.



*(Referred to in PCT Gazette No.09/1999, Section II)

FOR THE PURPOSES OF INFORMATION ONLY

Codes used to identify States party to the PCT on the front pages of pamphlets publishing international applications under the PCT.

AL	Albania
AM	Armenia
AT	Austria
AU	Australia
AZ	Azerbaijan
BA	Bosnia and Herzegovina
BB	Barbados
BE	Belgium
BF	Burkina Faso
BG	Bulgaria
BJ	Benin
BR	Brazil
BY	Belarus
CA	Canada
CF	Central African Republic
CG	Congo
CH	Switzerland
CI	Côte d'Ivoire
CM	Cameroon
CN	China
CU	Cuba
CZ	Czech Republic
DE	Germany
DK	Denmark
EE	Estonia
ES	Spain
FI	Finland
FR	France
GA	Gabon
GB	United Kingdom
GE	Georgia
GH	Ghana
GN	Guinea
GR	Greece
HU	Hungary
IE	Ireland
IL	Israel
IS	Iceland
IT	Italy
JP	Japan
KE	Kenya
KG	Kyrgyzstan
KP	Democratic People's Republic of Korea
KR	Republic of Korea
KZ	Kazakstan
LC	Saint Lucia
LI	Liechtenstein
LK	Sri Lanka
LR	Liberia
LS	Lesotho
LT	Lithuania
LU	Luxembourg
LV	Latvia
MC	Monaco
MD	Republic of Moldova
MG	Madagascar
MK	The former Yugoslav Republic of Macedonia
ML	Mali
MN	Mongolia
MR	Mauritania
MW	Malawi
MX	Mexico
NE	Niger
NL	Netherlands
NO	Norway
NZ	New Zealand
PL	Poland
PT	Portugal
RO	Romania
RU	Russian Federation
SD	Sudan
SE	Sweden
SG	Singapore
SI	Slovenia
SK	Slovakia
SN	Senegal
SZ	Swaziland
TD	Chad
TG	Togo
TJ	Tajikistan
TM	Turkmenistan
TR	Turkey
TT	Trinidad and Tobago
UA	Ukraine
UG	Uganda
US	United States of America
UZ	Uzbekistan
VN	Viet Nam
YU	Yugoslavia
ZW	Zimbabwe

TITLE

BURNISHED VEHICLE WHEEL

CROSS REFERENCE TO RELATED APPLICATION

This application claims the benefit of U.S. Provisional Application No. 60/039,628, filed March 19, 1997.

BACKGROUND OF THE INVENTION

This invention relates in general to vehicle wheels and in particular to a vehicle wheel having an outboard face which includes a burnished portion to provide a cosmetic finish to the wheel face and a method for burnishing the portion of the wheel face.

Vehicle wheels typically include an annular wheel rim and a circular wheel disc. The wheel disc can be formed across the outboard end of the wheel rim or recessed within the wheel rim. The wheel rim is adapted to carry a pneumatically inflated tire. The wheel rim has inboard and outboard tire retaining flanges formed on the ends thereof which extend in an outward radial direction to retain the tire on the wheel. Inboard and outboard tire bead seats are formed on the outer surface of the wheel rim adjacent to the corresponding tire retaining flange to support the tire walls and form an air-tight seal therewith. The wheel rim also includes a reduced diameter deep well between the tire bead seats to facilitate mounting the tire upon the wheel.

The wheel disc includes a central wheel hub for mounting the wheel upon a vehicle. The inboard face of the wheel hub is typically machined to form a flat surface to assure good contact between the wheel and the vehicle. A pilot hole and a plurality of wheel stud holes extend through the wheel hub. The pilot hole

is centered on the hub and the stud holes are spaced equally about a bolt circle which is concentric with the pilot hole. The pilot hole can receive the end of an axle while the wheel stud holes receive wheel studs for attaching the wheel to the vehicle. The wheel disc also typically includes a plurality of wheel spokes which extend radially from the wheel hub to the wheel rim and support the hub within the rim.

Referring now to the drawings, a flow chart for a wheel manufacturing process is shown in Fig. 1. In function block 10, a wheel cast in a single piece from a light weight metal such as aluminum, magnesium or titanium, or an alloy of a light weight metal. Such wheels are becoming increasingly popular because they weigh less than conventional steel wheels and can include outboard wheel disc faces which are formed in a pleasing aesthetic shape. One piece wheel castings are usually formed by a gravity or low pressure casting process. The wheel castings are finished by machining to a final shape.

Two separate machining stations are typically used to finish a wheel casting. In functional block 11, the outboard end of a rough wheel casting is clamped to the face of a first wheel lathe which is located at the first machining station for a first set of machining operations. A wheel lathe is a dedicated machine designed to finish wheels. Wheel lathes typically include a plurality of cutting tools mounted upon a lathe turret. The turret is indexed to sequentially move each of the tools to the surface of the wheel casting. Wheel lathes are usually operated under computer numerical control (CNC) to sequentially perform a number of related machining operations. For example, a wheel lathe turret can be equipped with a turning tool, a facing tool and a drill bit and the wheel lathe can be programmed to sequentially turn, face and bore a wheel casting. The wheel lathe face typically includes a chuck having a plurality of jaws which grip the outboard wheel retaining flange and tire bead seat.

Consequently, the outboard wheel rim end is not finished during the first set of machining operations.

The outside and inside surfaces of the wheel rim are turned to their final shapes and the inboard surface of the wheel hub is faced in functional block 12. Additionally, the inboard end of the wheel rim is finished. The partially finished wheel casting is removed from the first wheel lathe, reversed and clamped on a second wheel lathe for a second set of machining operations in functional block 13. During the second set of machining operations, the inboard wheel flange and tire bead seat are gripped in the jaws of the wheel lathe chuck, exposing the outboard surface of the wheel disc and the outboard end of the wheel rim for machining.

In functional block 14, the second wheel lathe turns and faces the outboard wheel face. During these operations, the outboard tire retaining flange and the outboard tire bead seat also are turned to final shapes. The surface of the hubcap retention area is machined to final shape and the stud mounting holes are drilled through the hub in functional block 15. Alternately, the wheel casting may be removed from the wheel lathe and the drilling operation completed at another work station.

During the facing and other machining operations, very fine grooves are formed in the surfaces of the wheel. Accordingly, the surface of the wheel is typically subjected to a finishing step, as shown in functional block 16. A typical finishing process involves polishing the wheel surface to smooth the grooves and provide a lusterous appearance to the surface of the wheel. The polishing is usually followed by application of a clear coating to protect the polished wheel surface.

A typical polishing operation is illustrated by a flow chart in Fig. 2. Polishing typically involves a first step of rough buffing with an abrasive

compound as shown in functional block 20. The buffed wheel is degreased in functional block 21. One frequently used method of degreasing involves passing the wheel through a chamber which is filled with a vapor of a solvent. The solvent condenses upon wheel, covering the entire wheel surface. Once the solvent has had a sufficient time to dissolve any surface grease, the solvent is washed from the wheel to complete the degreasing. As shown in functional block 22, the wheel is then wet polished with a liquid lubricant for the polishing abrasive. The wheel is usually rotated and rotating polishing wheels are applied to the surface while a slurry of polishing abrasive and a carrier fluid is applied to the wheel surface. Next the wheel is rinsed in functional block 23. Typically, deionized water is used for the rinse.

The wheel surface is prepared for coating in functional block 24. Typically, the wheel is immersed in a chromate bath. Finally, a clear coating is applied to the wheel in functional block 25. Usually, the clear coating is sprayed onto the wheel while the wheel is slowly rotated. The coating is then heated in a curing oven.

SUMMARY OF THE INVENTION

This invention relates to a wheel having an outboard face which includes a burnished portion to provide a cosmetic finish to the wheel face and a method for burnishing the portion of the wheel face.

As described above, it is known to buff or polish a wheel surface. However, such processes require abrasives and solvents. Typical solvents include trichloroethylene, trichloroethane, sulfuric acid and perchloroethylene, which are toxic. Additionally, the lubricants for the abrasives can include animal lubricants such as grease and lard. The polishing wheels can produce air-borne lint during the polishing and buffing operation. Accordingly, it is necessary to

protect the workers from these materials and collect and dispose of the residues. Because of the complexity of the polishing operations and the need to appropriately control the environmental impact of the materials utilized, wheels are often shipped to a contractor for polishing. This involves additional time and expense. Thus, it would be desirable to smooth the wheel face without polishing the wheel.

The present invention contemplates a vehicle wheel comprising an annular wheel rim portion and a wheel disc formed across the wheel rim. The wheel disc has an outboard face which includes a burnished portion to provide a pleasing cosmetic appearance. It is further contemplated that the burnished portion of the wheel disc face can extend over the entire surface of the wheel disc outboard face. An optional protective coating can be formed over the burnished portion of the wheel disc face.

The present invention further includes a process for forming a decorative surface upon a vehicle wheel face which comprises providing a machined vehicle wheel including a wheel rim and having a wheel disc extending radially across the wheel rim. The machined wheel is mounted in a lathe. The wheel is rotated while a burnishing tool is urged against the outboard surface of the wheel disc to smooth a portion of the wheel disc surface. The invention also contemplates burnishing the entire outboard face of the wheel disc. Subsequent to burnishing the wheel face, an optional protective coating can be applied to the burnished surface.

Various objects and advantages of this invention will become apparent to those skilled in the art from the following detailed description of the preferred embodiment, when read in light of the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a flow chart for a known process for manufacturing a one piece vehicle wheel.

Fig. 2 is a flow chart for a known process for polishing a one piece vehicle wheel.

Fig. 3 is a sectional view of a burnished vehicle wheel and illustrates a process for burnishing the vehicle wheel face in accordance with the invention.

Fig. 4 illustrates a burnishing tool used in the burnishing shown in Fig. 3.

Fig. 5 illustrates an alternate embodiment of the burnishing tool shown in Fig. 3.

Fig. 6 is a flow chart for manufacturing a one piece vehicle wheel which utilizes the burnishing process illustrated in Fig. 3.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring again to the drawings, there is illustrated in Fig. 3, a sectional view of a one piece wheel 30 having a burnished outboard surface 31 and a process for burnishing the wheel 30 in accordance with the present invention. Burnishing involves rubbing a smooth hard tool under considerable pressure over the minute surface protrusions that are formed in a metal surface during machining. Burnishing reduces the depth and sharpness of the protrusions through plastic flow of the metal. As the tool moves, the microscopic peaks in the work surface are compressed into the adjacent hollows, which densifies the surface of the metal. Burnishing simultaneously smoothes and compresses the work surface. The resulting mechanical forces, which impart compression stresses to the wheel, both on the surface and down to a certain depth of the work, increase the lifetime of the metal with respect to contact corrosion and fatigue. Additionally, the cosmetic appearance of the wheel is enhanced as

surface imperfections such as pits or oxides are plastically deformed into the surface of the wheel. An increased brightness or shine of the wheel surface is expected from the burnishing process. Thus, the present invention is directed to burnishing the visible portions of a wheel face, which includes portions of the wheel which are not subjected to stress, to cosmetically improve the appearance of the wheel face.

As shown in Fig. 3, the wheel 30 includes an annular wheel rim 32. A wheel disc 33 which includes the outboard surface 31 extends radially across the outboard end of the wheel rim 32. The invention contemplates mounting an inboard end of the wheel rim 32 in the jaws 34 of a lathe or a spinner chuck of a wheel lathe (not shown).

The wheel 30 is rotated about an axis 35, as shown by the arrow in Fig. 3, by the wheel lathe. A burnishing tool 40 mounted upon the lathe turret (not shown) is urged against the outboard wheel face 31. The tool 30 is traversed in a radial direction from the outboard end of the wheel rim 32 across the wheel face 31. The tool 40 moves alternately toward and away from the center of the wheel disc 33, as shown by the small arrows in Fig. 3. As the tool 40 moves across the wheel face 31, the tool 40 also is moved axially to follow the contour of the wheel face 31. The invention further contemplates that the burnishing tool 40 can be inclined to burnish all possible inclinations of the wheel face 31, such as horizontal, vertical or inclined. Additionally, the tool 40 can be advanced in an axial, or radial, direction to increase the force exerted upon the wheel face 31. The surface of the wheel face 31 is plastically deformed and smoothed as the tool 40 passes thereover to form a burnished portion 41 of the wheel face 31.

The invention further contemplates a protective coating 42 which covers the burnished portion 41 of the wheel; however, such a coating 42 is optional. In

the preferred embodiment, the protective coating 42 is a clear coating; however, other coatings can be applied to the burnished portion 41.

In the preferred embodiment, the burnishing tool 40 includes a very hard steel ball 43 mounted or formed upon an end of a tool bar 44, as shown in Fig. 4. the ball 43 has a mirror or very smooth surface and a hardness which is greater than 62 R_C. Alternately, the tool 40 can be a hardened roller 45 which turns on a shaft 46 mounted in the slotted end of a tool bar 47, as shown in Fig. 5.

A process for burnishing the wheel face is illustrated by the flow chart shown in Fig. 6. Steps shown in Fig. 6 which are similar to steps shown in Figs. 1 and 2 have the same numerical designators. In functional block 10 a vehicle wheel is cast by a conventional casting process, such as, for example, gravity or low pressure casting. In functional blocks 11 through 15, the wheel casting is machined to a final shape as described above.

In functional block 51, the outboard wheel face is burnished on a wheel lathe or other conventional wheel finishing machine. The wheel is rotated upon the wheel lathe while a burnishing tool is urged against and moved radially across the outboard wheel face. Once the desired surface finish has been achieved, the wheel is removed from the wheel lathe in functional block 52.

The wheel can then be finished with a surface preparation in functional block 25 followed by a coating and curing of the coating in functional block 25. As described above, application of the protective coating to the burnished surface is optional. Thus, the present invention contemplates that burnishing is included as one of the steps in the prior art process for machining a wheel casting. For example, a burnishing tool can be added to the turret of the wheel lathe used to machine the wheel casting and the burnishing operation included as one of the programmed machining steps for finishing the wheel casting. Alternately, a

burnishing station, which is dedicated to burnishing the wheel faces, can be established at the wheel manufacturing facility.

While the preferred embodiment has been described and illustrated above as burnishing the entire outboard wheel face, it will be appreciated that only a portion of the wheel face can be burnished. For example, the esthetic design of the wheel may require that only a portion of the wheel face is to be lusterous with the remainder remaining as machined or painted. Accordingly, only the portion which is desired to be luterous would be burnished. Similarly, the invention also contemplates that entire surface of wheel can be burnished to provide both an improvement in the cosmetic appearance to the wheel and the enhanced mechanical properties mentioned above which result from the compression stresses imparted by the burnishing process. Also, while the preferred embodiment has been described as being applied to cast wheels, it will be appreciated that the cosmetic appearance of wheels formed by other conventional processes also can be improved by burnishing. For example, the present invention also contemplates burnishing the outboard surface of forged or stamped wheel discs.

The inventor expects that burnishing of the wheel face to enhance the cosmetic appearance thereof will cost less than buffing or polishing of the wheel face. Also, because the wheel can be burnished on existing wheel lathes, no capital cost for polishing machines is required. The burnishing process eliminates both the exposure of personnel to toxic substances utilized during polishing and the expense of disposing of the toxic wastes generated thereby. Production time and cost will also be reduced since the need to ship the wheel to a polishing contractor will be eliminated. The burnishing tool can extend into the wheel rim to reach the surface of a recessed wheel disc, which can be difficult to reach with polishing wheels. Burnishing preserves crisp edge

surfaces which may be aesthetically desirable. Such edges tend to be blunted or removed by the abrasive nature of the polishing process. As described above, because surface imperfections such as pits or oxides are plastically deformed into the surface of the wheel face, a better brightness or shine of the wheel face is expected. While polishing tends to highlight surface imperfections, burnishing tends to hide such surface imperfections. Additionally, fatigue resistance of the wheel is increased over that obtained by polishing due to the residual compressive stresses induced in the wheel surface by the burnishing process.

In accordance with the provisions of the patent statutes, the principle and mode of operation of this invention have been explained and illustrated in its preferred embodiment. However, it must be understood that this invention may be practiced otherwise than as specifically explained and illustrated without departing from its spirit or scope. For example, while the preferred embodiment has been described for a one piece vehicle wheel, it will be appreciated that the invention also can be practiced upon two piece vehicle wheels having cast full face modular wheel discs. Also, the invention can be practiced upon a wheel spider which is disposed within a wheel rim. Additionally, while burnishing of only wheel faces has been described above, the invention also contemplates burnishing other machined wheel surfaces.

What is claimed is:

1. A vehicle wheel comprising:

an annular wheel rim portion; and

a wheel disc formed across said wheel rim, said wheel disc having an outboard face, said outboard face including burnished portion which provides a pleasing cosmetic appearance.

2. A vehicle wheel according to claim 1 wherein said burnished portion of said wheel disc face extends over the entire surface of said wheel disc outboard face.

3. A vehicle wheel according to claim 2 further including a protective coating formed over said burnished portion of said wheel disc face.

4. A vehicle wheel according to claim 3 wherein said protective coating is a clear coating.

5. A process for forming a decorative surface upon a vehicle wheel face comprising the steps of:

(a) providing a machined vehicle wheel including a wheel rim and having a wheel disc extending radially across the wheel rim;

(b) mounting the wheel in a lathe;

(c) rotating the wheel; and

(d) urging a burnishing tool against the outboard surface of the wheel disc to smooth a portion of the wheel disc surface; and

6. A process according to claim 5 further including, subsequent to step (d), removing the burnished wheel from the lathe.

7. A process according to claim 5 wherein the entire outboard face of the wheel disc is burnished in step (c).

8. A process according to claim 5 further including, subsequent to step (d), applying a protective coating to the burnished surface.

9. A process according to claim 8 wherein the coating is a clear coating.

10. A process according to claim 5 wherein the burnishing tool includes a spherical surface which is pressed against the wheel surface in step (d).

11. A process according to claim 5 wherein the burnishing tool includes a roller which is pressed against the wheel surface in step (d).

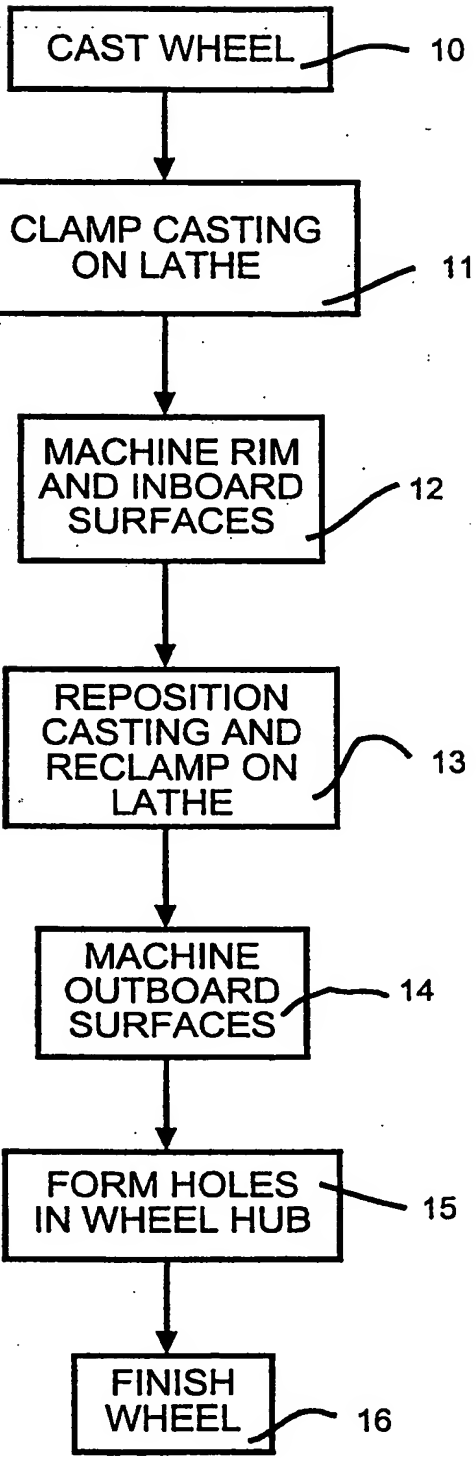


FIG. 1

(PRIOR ART)

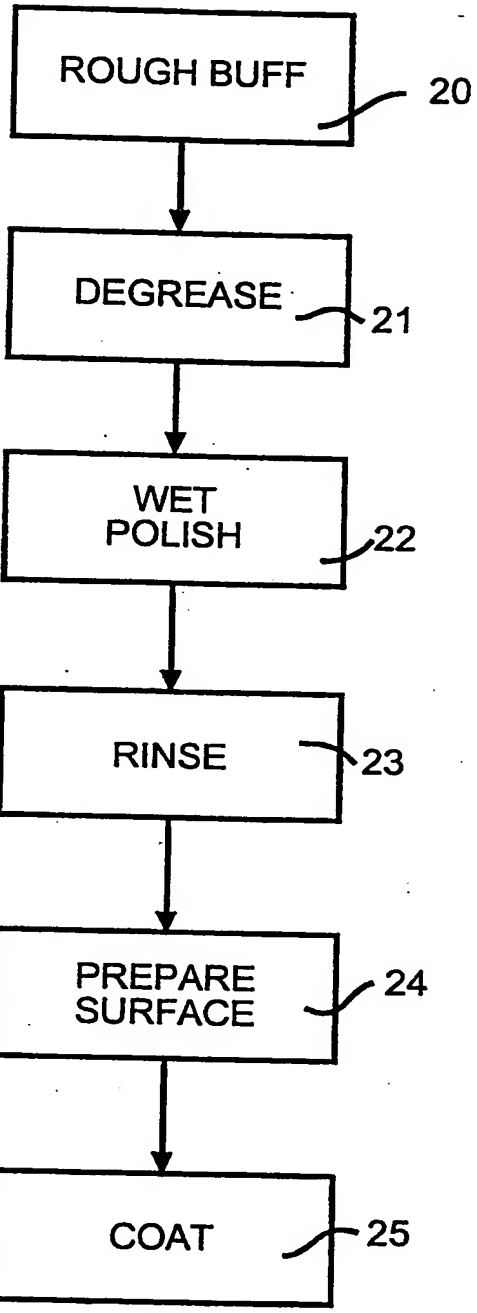


FIG. 2
(PRIOR ART)

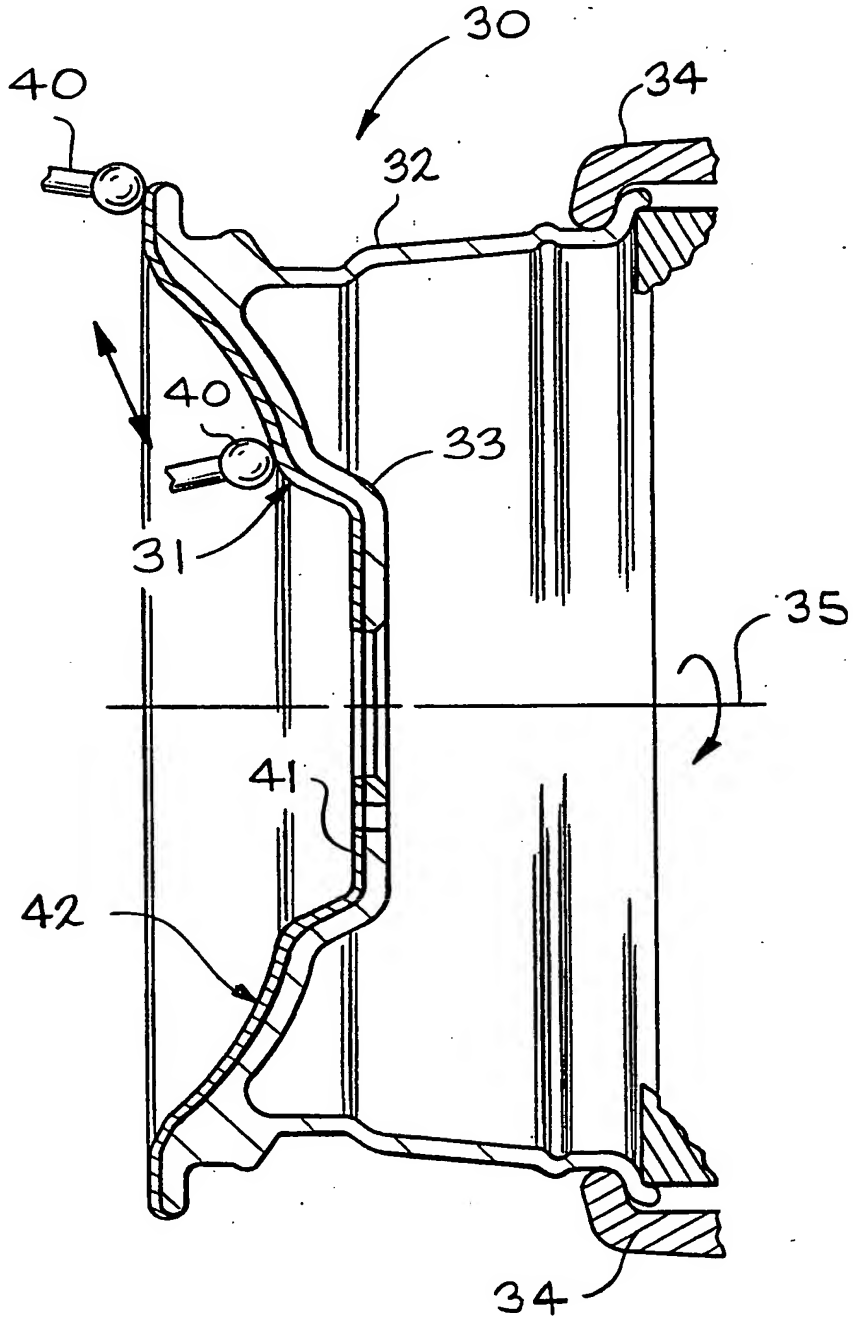


FIG. 3

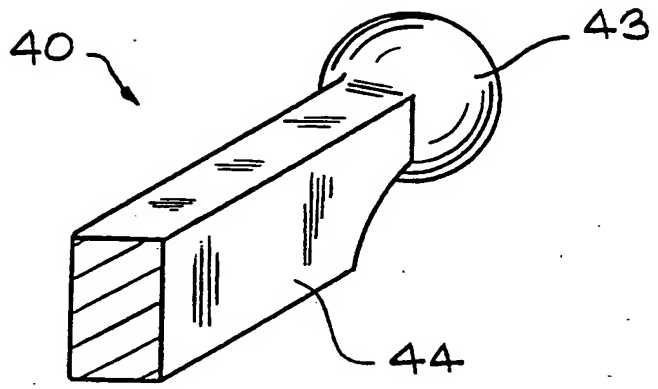


FIG. 4

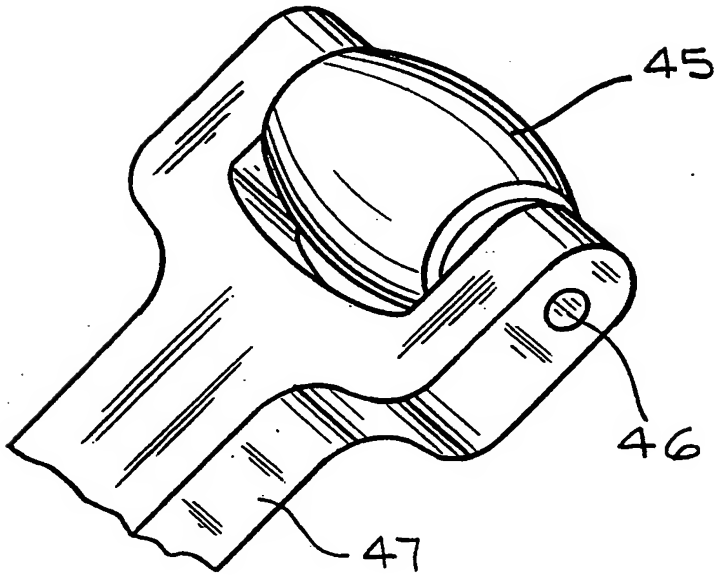


FIG. 5

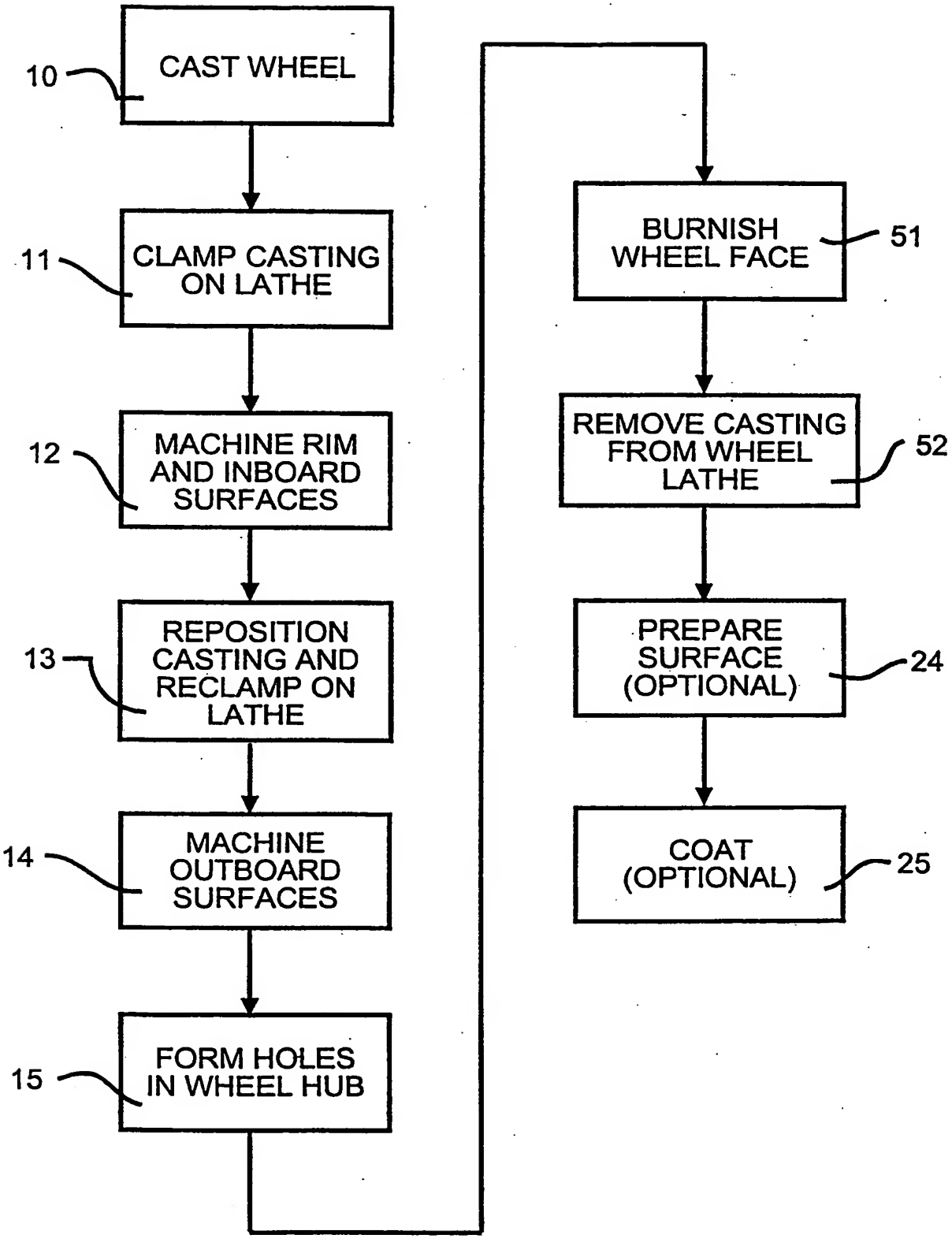


FIG.6

INTERNATIONAL SEARCH REPORT

International Application No
PCT/US 98/05808

A. CLASSIFICATION OF SUBJECT MATTER
IPC 6 B24B39/04 B60B3/06

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 6 B24B B60B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 4 835 826 A (WILSON) 6 June 1989 see column 2, line 57 - column 4, line 46; figures	1,5,10, 11
X	US 5 099 558 A (WILSON) 31 March 1992 see column 2, line 57 - column 4, line 41; figures	1,5,10, 11
X	US 5 329 684 A (BUDET) 19 July 1994 see column 3, line 59 - column 8, line 12; figures	1,5

-/--

[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

° Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
14 July 1998	21/07/1998

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Vanneste, M

Form PCT/ISA/210 (second sheet) (July 1992)

INTERNATIONAL SEARCH REPORT

International Application No
PCT/US 98/05808

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	PATENT ABSTRACTS OF JAPAN vol. 008, no. 212 (C-244), 27 September 1984 & JP 59 098774 A (TOYOTA JIDOSHA KK), 7 June 1984, see abstract	3,4
A	PATENT ABSTRACTS OF JAPAN vol. 096, no. 004, 30 April 1996 & JP 07 329502 A (NISSAN MOTOR CO LTD), 19 December 1995, see abstract	3,4
A	DE 26 24 610 A (NSU) 8 December 1977 see page 4, line 17 - page 5, line 6; figures	1

Form PCT/ISA/210 (continuation of second sheet) (July 1992)

INTERNATIONAL SEARCH REPORT

Information on patent family members

In itional Application No
PCT/US 98/05808

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 4835826 A	06-06-1989	US 5099558 A	31-03-1992
US 5099558 A	31-03-1992	US 4835826 A	06-06-1989
US 5329684 A	19-07-1994	FR 2687341 A	20-08-1993
		EP 0556102 A	18-08-1993
DE 2624610 A	08-12-1977	NONE	